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Cold Regions Research & Engineering Laboratory

Ice Engineering

U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire

Ice Jams, Winter 1999–2000

Ice jams are accumulations of ice that form on rivers, often constricting water flow or flooding low-lying areas upstream from the jam. The ice jams may form during the initial ice formation period (freezeup jams), or when the ice cover begins to break up and move downstream (breakup jams). The likelihood of an ice jam is increased by local river geometry, weather characteristics, and floodplain land-use practices. Places where the river suddenly changes from a steep to a gradual slope or where there are bends in the river, bridges, and piers all tend to be more likely to experience ice jams (USACE 1994).

Because ice jams have dramatic effects on flow, they can be accompanied by severe flooding. The sudden increase in water level during an ice jam can occur rapidly, leaving little time for state officials and engineers to react to the situation or prevent costly damages. The rapid rise of water can lead to flooding, thereby damaging buildings, cars, and personal property, destroying or weakening bridges, and closing roads (Fig. 1).

Severe ice jam conditions can lead to evacuations of communities flooded by the rapidly rising water. Ice jams can also delay or block river transportation, halting the shipment of essential material such as heating fuel or road salt for icy roads. Vegetation along riverbanks can be damaged and sediments along river bottoms can be disturbed, with adverse impacts on fish and wildlife habitat. Damages from ice jams have been estimated to cost the United States $100 million annually.

Figure 1. Missisquoi River ice jam threatening home along Route 78 near East Highgate, Vermont, February 2000. Photo courtesy of Greg Hanson, NWSFO BTV.

Accurate and reliable ice jam information is essential in order to be best prepared for future ice jam events. This information can help engineers and state officials prevent or alleviate ice jams by providing data about past events, the conditions surrounding their formation, and the actions taken in response to the event. The Cold Regions Research and Engineering Laboratory (CRREL) Ice Jam Database is a compilation of freezeup and breakup ice jam events in the United States (White 1999). Currently there are 12,500 entries in the database, dating from 1780. CRREL's database provides a reliable resource to research previous ice jams, including river names, locations by U.S. Geologic Survey hydraulic and gage number, latitude and longitude, city and state, date and type of jam, a brief description of the situation, and publications with information on the particular jam. This information can be used to predict and assess conditions that may increase the probability of ice jam formation. The database provides a source of information regarding the success or failure of various emergency response efforts undertaken by engineers and relief officials during previous ice jam events. The design of ice mitigation measures, such as the Hardwick, Vermont, ice control structure on the Lamoille River (Fig. 2), also relies on information collected in the database.

This issue provides a brief summary of the ice jam events for Water Year 2000 (1 October 1999 through 30 September 2000). Currently, there are 62 entries in the database for 2000. Much of the information about field conditions was provided by daily bulletins and reports from the National Weather Service (NWS) and from the U.S. Geological Survey (USGS). Of these ice jam events, 59% reported damages, including flooding in lowland fields, roads, and several houses (Fig. 1).

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Figure 2. Ice jammed on the Lamoille River at the Hardwick, Vermont, ice control structure during ice cover breakup on 28 February 2000.

When did ice jams occur in 2000?

The greatest number of ice jams occurred in February, accounting for 77% of the total ice jams of 2000 (Fig. 3). Even within the month, the jams were heavily grouped, with 56% of the February jams occurring between the 25th and 29th. January was the second most common month, with 11% of ice jams, most occurring in mid- to late January. March and April had 10% and 2%, respectively. A combination of several conditions encouraged these ice jams patterns. Extremely cold temperatures in January created thick ice covers on the rivers of the Northeast. The ice was thicker than normal because the sparse snow provided little insulation against the freezing temperatures. In late February, air temperatures rose rapidly, resulting in snowmelt of between 10 to 30 inches in the Adirondacks, the Green Mountains, and the St. Lawrence Valley. This warm air, combined with a rain event that began the last five days of February, caused water levels to rise. The ice cover began to break up rapidly, forming numerous ice jams throughout the region (Hanson 2000). The thicker ice, often up to four feet thick, caused especially severe ice jams in some areas.

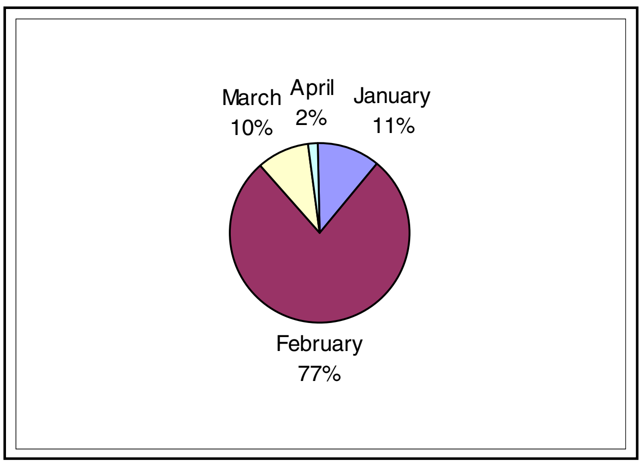

Figure 3. Water year 2000 ice jam distribution by month.

Where did ice jams occur in 2000?

Ice jams occurred in 11 states during water year 2000 (Fig. 4). New York had 16 ice jams, more than any other state recorded in water year 2000 (Fig. 5). Vermont and Maine both had several jams—15 and 9, respectively. Pennsylvania and New Hampshire each had six ice jams, while the rest of the states all had three or fewer events. The Mohawk, Great Chazy, and the Hudson Rivers all contributed to the large number of ice jams in New York.

In New York, several homes were surrounded by water in Perry Mills when the Great Chazy River overflowed its banks because of an ice jam (Hanson 2000). Just downstream, a separate river ice jam flooded the Village of Champlain. Local emergency teams tried to prevent the jam from flooding the town by removing the ice with an excavator. When this proved unsuccessful, dynamite was used to blast the ice jam, which had grown to a thickness of four feet (NWS report, 6 March 2000).

The Susquehanna River and Clearfield Creek were sources of Pennsylvania's ice jams. Four of Maine's nine events occurred on the St. John River in late March when the river began to break up. Vermont experienced the most ice jams on one river when the Winooski River experienced five different ice jams during the course of the winter (Fig. 6). Vermont also experienced some dramatic flooding. Route 78 was closed when the Missisquoi River, forced out of its banks by an ice jam, covered the road with one- to two-foot-thick chunks of ice. A house was completely surrounded by large pieces of ice almost three feet thick (Fig. 1).

The ice jams of 2000 also provided an opportunity for the further development of a method to study ice jams through tree scars. A study performed by the Geology Department of Union College focused on the severe ice jams along the Mohawk River that flooded Schenectady, New York, in February 2000 (Lederer and Garver 2001). The marks and scars left on trees by the passing ice can be used to determine the downstream ice elevations during severe ice jams and can provide more accurate information about the exact location of ice jams. Perhaps most useful, they can provide a clue to ice jams that have long since passed but whose scars remain on the trees.

Corps response

In 2000, the U.S. Army Corps of Engineers provided technical, financial, and mechanical resources to communities affected by ice jams and subsequent flooding. CRREL provided recommendations, referrals, on-site observations, and points of contact to the Corps in other regions.

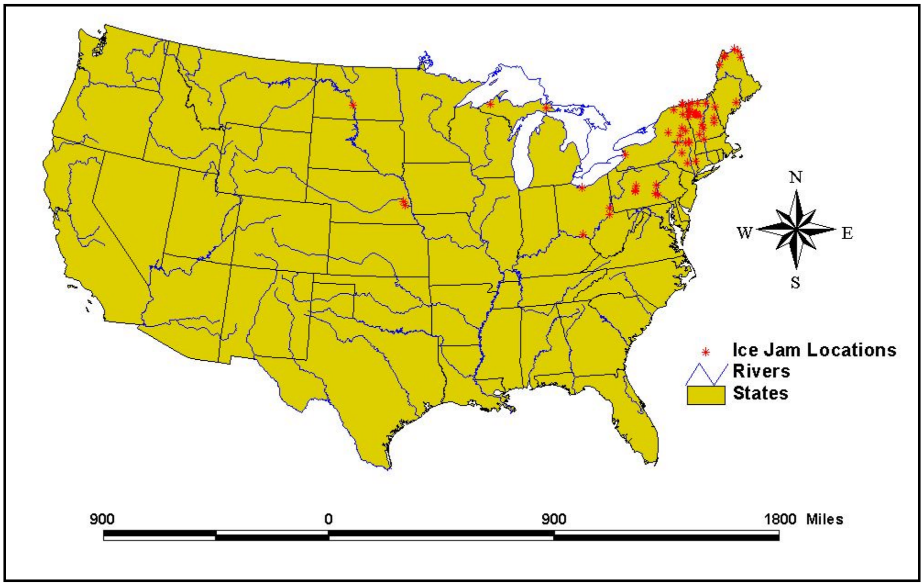

Figure 4. Ice jam locations during water year 2000.

For example, in mid-January 2000, intense cold resulted in the formation of a freezeup ice jam in downtown Augusta, Maine. The jam formed near the head of tide about 500 ft downstream from the site of the Edwards Dam, which had been completed in 1837 and removed in July 2000. Anecdotal evidence suggested that while the dam was in place, an open-water area about 1000 ft long extended downstream from the Edwards Dam where the 2000 jam formed. The freezeup jam was about one mile long, and measured ice thickness ranged up to 9 ft. Substantial frazil deposition beneath the jam was noted, reaching the bed in some near-bank locations. The jam raised stages about 3 to 4 ft and was not considered a flood threat in itself. However, the potential for a later breakup jam to occur at this location posed a serious flood threat.

The New England District requested technical assistance from CRREL, in cooperation with the USGS and NWS, to support local and state emergency management agencies by providing monitoring equipment and training for a monitoring program carried out by local, state, and federal agencies. Ice motion detectors were placed at five locations along the river to provide early warning of ice cover breakup, movement, and potential jamming. Fortunately, warm days and cool nights in March led to the deterioration of the upstream ice cover and the jam, preventing additional jamming.

How is this information helpful?

This overview of 2000 ice jams is the fifth entry in a series of yearly ice jam summaries. The Ice Jam Database is updated yearly to provide a publication that summarizes the most current information on when and where ice jams occurred,

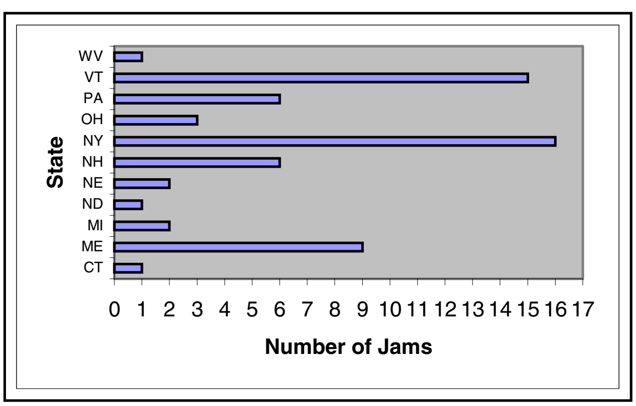

Figure 5. Water year 2000 ice distribution by state.

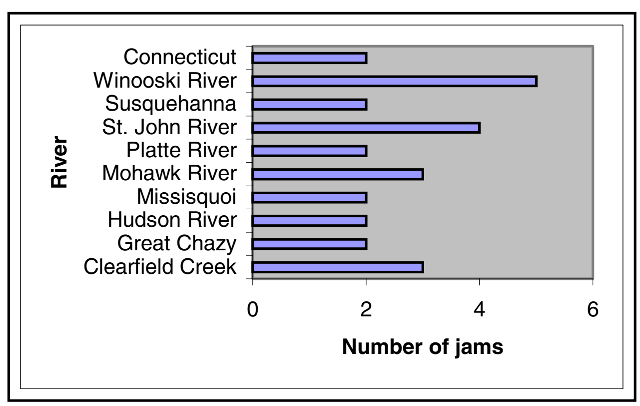

Figure 6. Several rivers had two or more ice events during water year 2000.

resulting damages, and the Corps response. Historical information about ice jams is essential in emergency situations to describe conditions of previous events at the site and to determine how emergency personnel responded to the situation. Knowing the historical patterns of a site may help to predict or even prevent ice jam formation, and to prepare a community for dealing with the situation should the need arise.

CRREL also has an Ice Jam Archive containing hard copies of the information used in annual reports. Information sources include NWS reports, newspaper articles, and other reports used for information about current and past water years. These records can be photocopied or checked out for research purposes.

Please send information for the Ice Jam Database or Ice Jam Archive to Kate White, CRREL, 72 Lyme Road, Hanover, NH 03755-1290 (e-mail Kathleen.D.White@erdc.usace.army.mil). The Ice Jam Database is available via CRREL's Web site (http://www.crrel.usace.army.mil/) or can be directly accessed at http://www.crrel.usace.army.mil/ierd/ijdb/index.html.

References

Hanson, G. (2000) Flooding 2/2000. Burlington, Vermont: National Weather Service. (http://www.nws.noaa.gov/er/btv/html/NCO_Internet/APR00_Issue/links_folder/NCO_flooding.htm)

Lederer, J., and J. Garver (2001) Ice jams on the Lower Mohawk River (Crescent, New York) formed during the 2000 mid-winter flood. Schenectady, New York: Union College. (http://zircon.geology.union.edu/Mohawk_ice/2000_jam.html)

USACE (1994) Engineering and design—Ice jam flooding: Causes and possible solutions. Pamphlet No. 1110-2-11.

White, K.D. (1999) CRREL ice jam database. U.S. Army Cold Regions Research and Engineering Laboratory Special Report 99-2.

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